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High-pressure discharge lamp

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High-pressure discharge lamp

The invention relates to a high-pressure discharge lamp provided with an outer bulb in which a discharge vessel is arranged around a longitudinal axis,

the discharge vessel enclosing, in a gastight manner, a discharge space provided with an ionizable filling,

the discharge vessel having a first and a second mutually opposed neck-shaped portion through which a first and a second current supply conductor, respectively, extend to a pair of electrodes arranged in the discharge space,

a lamp base of electrically insulating material supporting the discharge vessel via the first and second current supply conductors,

the lamp base also supporting the outer bulb,

the outer bulb enclosing the first and second current supply conductors.

High-pressure discharge lamps ranging from 35 to 150 W have become a dominant player in lighting retail applications. Trends have emerged which create positive conditions for range extensions towards lower lumen packages and/or lower wattages. Lower light levels are being used, for instance in exclusive shops, focusing the light on the goods instead of flooding the area. End users in the market become more and more interested in a uniform quality of the light and would prefer to employ high-pressure discharge lamps in stead of using halogen lamps for the low lumen packages and accent lighting.

Generally, high-pressure discharge lamps of the kind mentioned in the opening paragraph either have a discharge vessel with a ceramic wall or have a quartz glass discharge vessel. Such high-pressure discharge lamps are widely used in practice and combine a high luminous efficacy with favorable color properties. The discharge vessel of the lamp contains one or several metal halides in addition to Hg and a rare gas filling.

A ceramic wall of a discharge vessel in the present description and claims is understood to be a wall made from one of the following materials: monocrystalline metal oxide (for example sapphire), translucent densely sintered polycrystalline metal oxide (for example Al_2O_3, YAG), and translucent densely sintered polycrystalline metal nitride (for example AlN).

A lamp of the kind mentioned in the opening paragraph is known from the English abstract of JP-A 04 002 035. The known discharge lamp comprises a discharge vessel and current supply conductors supporting the discharge vessel while installed projectively at a lamp base of an insulating material. An outer bulb of which one end is left open is fixed to the lamp base enclosing the discharge vessel and the current supply conductors.

A disadvantage of the known high-pressure discharge lamp is that the service life of the discharge lamp is below the desired level.

The invention has for its object to provide a measure by which the above disadvantage is eliminated. According to the invention, a high-pressure discharge lamp of the kind mentioned in the opening paragraph is for this purpose characterized in that the outer bulb is connected to the lamp base in a gas-tight manner.

By controlling the atmosphere in the outer bulb, the current supply conductors are well protected against oxidation. By controlling the atmosphere in the outer bulb is meant evacuating the outer bulb or providing an air-tight environment which in particular is free from oxidizing agents, like oxygen. Alternatively, controlling the atmosphere in the outer bulb does not exclude that means are provided in the outer bulb to control the atmosphere in the outer bulb. In an embodiment of the invention, the outer bulb is filled with nitrogen gas comprising, for instance, a small percentage of oxygen. By controlling the oxidation of the current supply conductors, the current supply conductors can be positioned relatively close to the discharge vessel. Normally, press seals and/or tipped-off (quartz) tubulations are provided to reduce oxidation of the current supply conductors, leading to a bulky and lengthy high-pressure discharge lamp. For quartz discharge vessels, the press seal and current supply conductors are preferably dimensioned such as to attain the desired life by operation in air. For ceramic discharge vessels employing niobium current supply conductors niobium oxidizes very quickly at the operating temperatures of the discharge vessel, leading to a very limited life span of the high-pressure discharge lamp.

By controlling the atmosphere in the outer bulb, a simplified and compact high-pressure discharge lamp can be made. In particular, the length of the high-pressure discharge lamp can be significantly reduced. To this end a preferred embodiment of the high-pressure discharge lamp is characterized in that the ratio between the distance d_e between the

electrodes and the height h_{dl} of the high-pressure discharge lamp along the longitudinal axis ranges from:

$$0.02 \leq \frac{d_e}{h_{dl}} \leq 0.2.$$

According to this embodiment of the invention, the height h_{dl} of the high-pressure discharge lamp along the longitudinal axis can be smaller than approximately 50 mm for a distance d_e between the electrodes ranging from approximately 1 mm to approximately 10 mm.

The high-pressure discharge lamp according to the invention has the advantage that when the lamp is in operation the discharge vessel has optically very compact virtual dimensions, which render the lamp highly suitable for use in compact luminaires.

A preferred embodiment of the high-pressure discharge lamp according to the invention is characterized in that an exhaust tube for evacuating the lamp bulb is provided in the lamp base or in the outer bulb. This has the advantage that the outer bulb can be evacuated via the exhaust tube after the discharge vessel and the outer bulb have been mounted on the lamp base of the high-pressure discharge lamp. In a further preferred embodiment the exhaust tube also forms a feedthrough element to a current supply conductor of the discharge vessel of the lamp. This has the advantage of a simpler lamp construction.

A preferred embodiment of the high-pressure discharge lamp according to the invention is characterized in that the lamp base is made from quartz glass, hard glass, soft glass or a ceramic material. Preferably, the lamp base is a sintered body, preferably, a glass, a glass-ceramic or a ceramic body. Preferably the base is coloured whitish, so as to reflect extra light into usable beam angles, which increases the luminous efficacy of the lamp effectively. Preferably, the lamp base is in the form of a plate.

The lamp base can be manufactured with a high dimensional accuracy. It is favorable when the lamp base is plane at its surface facing away from the discharge vessel. This surface may be mounted against a (lamp) holder, for example a carrier, and accordingly is a suitable surface for serving as a reference for the position of the discharge vessel.

A preferred embodiment of the high-pressure discharge lamp according to the invention is characterized in that the outer bulb is fastened to the lamp base by means of an enamel. Preferably, the enamel is provided in the form of a previously shaped ring. Using a previously shaped ring largely simplifies the manufacturing of the high-pressure discharge lamp.

At the end of life (EOL) of the lamp a reduced fill pressure in the lamp allows a glow discharge which can be sustained for a long period of time (hundreds of houns). The glow discharge causes sputtering of the frame wire material resulting in a mirror around the press seal which can trigger tte so-called incandescent mode, whereby the press seal, molybdenum foils, molybdenum leads, base, lamp holder and wiring overheat drastically, often exceeding temperatures for the safe material constraints. This is a drawback.

According to the invention the drawback is counteracted in that in a preferred embodiment of the invention the combination of the lamp base formed by the base plate and the first and second contact members to respective current supply conductors, for instance from NiFeCr alloy like vacovit, serve as a fuse in the EOL process, melting or cracking under the stresses induced by the arc discharge between the said current conductors. Rapid failure prevents the development of dangerous incandescent modes.

The invention will now be explained in more detail with reference to a number of embodiments and a drawing, in which:

Fig 1A diagrammatically shows a high-pressure discharge lamp according to the invention;

Fig. 1B a cross-section of the high-pressure discharge lamp as shown in Fig. 1A;

Fig. 2 shows an alternative embodiment of the high-pressure discharge lamp according to the invention;

Fig. 3 shows another alternative embodiment of the high-pressure discharge lamp according to the invention;

Fig. 4 shows a further alternative embodiment of the high-pressure discharge lamp according to the invention, and

Fig. 5 shows a still further alternative embodiment of the high-pressure discharge lamp according to the invention.

The Figures are purely diagrammatic and not drawn true to scale. Some dimensions are particularly strongly exaggerated for reasons of clarity. Equivalent components have been given the same reference numerals as much as possible in the Figures.

Figure 1A shows an artists impression of a high-pressure discharge lamp according to the invention. Figure 1B shows diagrammatically a cross-section of the high-pressure discharge lamp as shown in Figure 1A. The high-pressure discharge lamp comprises

a discharge vessel 11 arranged around a longitudinal axis 22. The discharge vessel 11 encloses, in a gastight manner, a discharge space 13 provided with an ionizable filling comprising mercury, a metal halide and a rare gas. In the example of Figure 1A and 1B, the discharge vessel 11 has a first neck-shaped portion 2 and a second mutually opposed neck-shaped portion 3 through which portions a first current supply conductor 4 and a second current supply conductor 5, respectively, extend to a pair of two electrodes 6, 7, which electrodes 6, 7 are arranged in the discharge space 13. The high-pressure discharge lamp is further provided with a lamp base 8 made from an electrically isolative material. The lamp base 8 supports the discharge vessel 11 via the first and second current supply conductors 4, 5. The lamp base 8 also supports the outer bulb 1. In the example of Figure 1A and 1B, the lamp base 8 is provided with a first contact member 14 which is connected to the first current supply conductor 4. In addition, the lamp base 8 is provided with a second contact member 15 connected to the second supply conductor 5 via a connection conductor 16 running alongside the discharge vessel 11.

According to the invention the combination of the lamp base 8 formed by the base plate and the first and second contact members 14, 15 to respective current supply conductors 4,16, 5, for instance from NiFeCr alloy like vacovit, serve as a fuse in the EOL process, melting or cracking under the stresses induced by the arc discharge between the said current conductors. Rapid failure prevents the development of dangerous incandescent modes.

In an alternative embodiment, at least one contact member is formed by a feedthrough tube in the lamp base, which allow one of the current supply conductors to be fastened in said feedthrough tube. Alternatively two feedthrough tubes may be provided in the lamp base. The fastening in these feedthrough tubes may be done by resistance, laser welding or crimping. An advantage of the use of feedthrough tubes in stead of the contact members, is that more freedom of positioning the discharge vessel on the longitudinal axis of the high-pressure discharge lamp is attained. This may further improve the precise positioning of the discharge vessel in the outer bulb of the high-pressure discharge lamp.

According to the invention, the outer bulb 1 is connected to the lamp base 8 in a gas-tight manner. By controlling the atmosphere in the outer bulb, the current supply conductors 4, 5 are well protected against oxidation. By preventing oxidation of the current supply conductors 4, 5, the current supply conductors 4, 5 can be positioned relatively close to the discharge vessel 11. By controlling the atmosphere is the outer bulb, press seals and/or tipped-off (quartz) tabulations can be avoided resulting in a simplified and compact high-pressure discharge lamp. Preferably, an exhaust tube 18 for evacuating the lamp bulb 1 is

provided in the lamp base 8. In this manner, the outer bulb 1 can be evacuated via the exhaust tube 18 after the discharge vessel 11 and the outer bulb 1 have been mounted on the lamp base 8 of the high-pressure discharge lamp. After evacuating and, if desired, providing the desired atmosphere inside the outer bulb, the exhaust tube 18 is sealed off. Preferably, a getter is used inside the outer bulb, for instance a mix of water/hydrogen/oxygen to absorbed impurities. It is advantageous if the exhaust tube 18 in the lamp base 8 is made from a metal or from a NiFeCr alloy.

Preferably, the lamp base 8 is preferably made from quartz glass, hard glass, soft glass, glass-ceramic or a ceramic material. In addition, the lamp base 8 is provided as a sintered body, preferably, a sintered ceramic body. Preferably, the lamp base 8 is in the form of a plate. The lamp base 8 can be manufactured with a high dimensional accuracy. The lamp base 8 has the additional advantage that it can be made in a light color, for example white or a pale grey. By employing a material with a light color, light emitted by the discharge vessel 11 will be reflected into usable beam angles, thereby increasing the efficiency of the luminaire or the total efficiency of the high-pressure discharge lamp. It is prevented thereby that the light incident on the lamp base 8 is lost to the light beam which may be formed by means of a reflector. In addition, it is favorable when the lamp base 8 has a (flat) plane at its surface facing away from the discharge vessel 11. This surface may be mounted against a (lamp) holder, for example a carrier, for instance a reflector, and accordingly is a suitable surface for serving as a reference for the position of the discharge vessel 11. In another favorable embodiment, the surface of the lamp base 8 facing the discharge vessel has a central elevation, which serves to center the discharge vessel 11 and enamel ring with respect to the lamp base 8 during the manufacture of the high-pressure discharge lamp.

Preferably, the outer bulb 1 is made from quartz glass, hard glass or soft glass. The outer bulb 1 is, preferably, fastened to the lamp base 8 by means of an enamel of (glass) frit. It is favorable when the enamel is provided in the form of a previously shaped ring. Using such a previously shaped ring largely improves the accuracy of the positioning of the discharge vessel 11 during the manufacture of the high-pressure discharge lamp. The choice of the enamel depends on the material of the outer bulb 1 and on the material of the lamp base 8.

In the example of Figure 1A and 1B, a substantially cylindrical outer bulb 1 is provided. Figure 2 shows an alternative embodiment of the high-pressure discharge lamp according to the invention. In the example of Figure 2, a substantially spherical outer bulb 1 is provided. Figure 3 shows a further alternative embodiment of the high-pressure discharge

lamp according to the invention. In the example of Figure 3, a so-called double-ended embodiment of the high-pressure discharge lamp is shown. Two lamp bases 8, 8' are provided between a substantially cylindrical outer bulb 1. The exhaust tube 18 is, preferably, provided only in one of the lamp bases 8.

In the examples of Figures 1A, 1B, 2 and 3, the discharge vessel 11 is made from a ceramic material. In Figure 2 a sealed exhaust tube 18' is provided in the outer bulb 1. By providing a glass or quartz tubulation in the outer bulb, an exhaust tube in the lamp base can be dispensed with. Figure 4 shows yet another alternative embodiment of the high-pressure discharge lamp according to the invention in which the discharge vessel 11 is made from quartz. In this embodiment the ionizable filling in the discharge space comprises mercury, a metal halide and a rare gas. In the example of Figure 4, part of the outer bulb is provided in a substantially spherical form. In an alternative embodiment shown in Figure 5, the exhaust tube 18 also forms a feedthrough tube to which the current conductor 14 is fastened.

By controlling the atmosphere in the outer bulb, a simplified and compact high-pressure discharge lamp can be made. In particular, the length of the high-pressure discharge lamp can be significantly reduced. To this end a preferred embodiment of the high-pressure discharge lamp is characterized in that the ratio between the distance d_e between the electrodes and the height h_{dl} of the high-pressure discharge lamp along the longitudinal axis ranges from:

$$0.02 \leq \frac{d_e}{h_{dl}} \leq 0,2$$

According to the invention, a simplified lamp design is provided which can be used as a building block for a family of products based on a modular capsule lamp. The discharge vessel 11 is supported on the current supply conductors 4, 5 that are fixedly connected to the base plate 8. The discharge vessel 11 as well as the current supply conductors 4, 5 are positioned in the outer bulb 1 which is kept under a controlled atmosphere. Elimination of the press seals and and/or tipped-off (quartz) tubulations results in a compact high-pressure discharge lamp. Preferably, the height h_{dl} of the high-pressure discharge lamp is equal to or less than 50 mm, preferably less than 40 mm. In addition, positioning issues of the discharge vessel 11 are eliminated due to the more controlled manufacturing of the high-pressure

discharge lamp with respect to the longitudinal axis 22 and, in addition, the discharge vessel 11 can be accurately positioned in a plane orthogonal to the longitudinal axis 22.

The scope of the invention is not limited to the embodiments. The invention is embodied in each new characteristic and each combination of characteristics. Any reference sign do not limit the scope of the claims. The word "comprising" does not exclude the presence of other elements or steps than those listed in a claim. Use of the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

CLAIMS:

1. A high-pressure discharge lamp provided with an outer bulb (1) in which a discharge vessel (11) is arranged around a longitudinal axis (22),

the discharge vessel (11) enclosing, in a gastight manner, a discharge space (13) provided with an ionizable filling,

the discharge vessel (11) having a first (2) and a second (3) mutually opposed neck-shaped portion through which a first (4) and a second (5) current supply conductor, respectively, extend to a pair of electrodes (6, 7) arranged in the discharge space (13),

a lamp base (8) of electrically insulating material supporting the discharge vessel (11) via the first and second current supply conductors (4, 5),

the lamp base (8) also supporting the outer bulb (1),

the outer bulb (1) enclosing the first and second current supply conductors (4, 5),

characterized in that,

the outer bulb (1) is connected to the lamp base (8) in a gas-tight manner.

2. A high-pressure discharge lamp as claimed in claim 1, characterized in that an exhaust tube (18, 18') for evacuating the lamp bulb (1) is provided in the lamp base (8) or in the outer bulb (1).

3. A high-pressure discharge lamp as claimed in claim 2, characterized in that the exhaust tube (18) in the lamp base (8) is made from a metal or from a NiFeCr alloy.

4. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the lamp base (8) is made from quartz glass, hard glass, soft glass, glass-ceramic or a ceramic material.

5. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the outer bulb (1) is fastened to the lamp base (8) by means of an enamel.

6. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the outer bulb (1) is made from quartz glass, hard glass or soft glass.

7. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the discharge vessel has a quartz wall or a ceramic wall.

8. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the lamp base (8) is provided with first and second contact members (14,15) connected to the respective first and second current supply conductor (4,5)

9. A high-pressure discharge lamp as claimed in claim 8, characterized in that at least one of the first and second contact members (14,15) is provided by a feedthrough tube in the lamp base (8).

10. A high-pressure discharge lamp as claimed in claim 2 and 9, characterized in that the feedthrough tube is formed by the exhaust tube in the lamp base (8)

11. A high-pressure discharge lamp as claimed in claim 1 or 2, characterized in that the ratio between the distance d_e between the electrodes (6, 7) and the height h_{lt} of the high-pressure discharge lamp along the longitudinal axis (22) ranges from:

$$0.02 \leq \frac{d_e}{h_{lt}} \leq 0.2.$$

12. A high pressure discharge lamp as claimed in claim 1, characterized in that the combination of the lamp base formed by the base plate and the first and second contact members to respective current supply conductors serve as a fuse in the EOL process, melting or cracking under the stresses induced by the arc discharge between the said current conductors.

ABSTRACT:

The invention relates to a high-pressure discharge lamp with an outer bulb (1) in which a discharge vessel (11) is arranged. The discharge vessel encloses a discharge space (13) with an ionizable filling. The discharge vessel has two mutually opposed neck-shaped portions (2, 3) through which current supply conductors (4, 5) extend to a pair of electrodes (6, 7) in the discharge space. A lamp base (8) of electrically insulating material supports the discharge vessel. The lamp base (8) also supports the outer bulb (1). The outer bulb encloses the current supply conductors. According to the invention, the outer bulb is connected to the lamp base in a gas-tight manner. By controlling the atmosphere in the outer bulb, a simplified and compact high-pressure discharge lamp is provided with an accurate positioning of the discharge vessel with respect to the optical axis of the lighting system.

According to the invention the combination of the lamp base formed by the base plate and the first and second contact members to respective current supply conductors serve as a fuse in the EOL process, melting or cracking under the stresses induced by the arc discharge between the said current conductors.

Fig. 1B

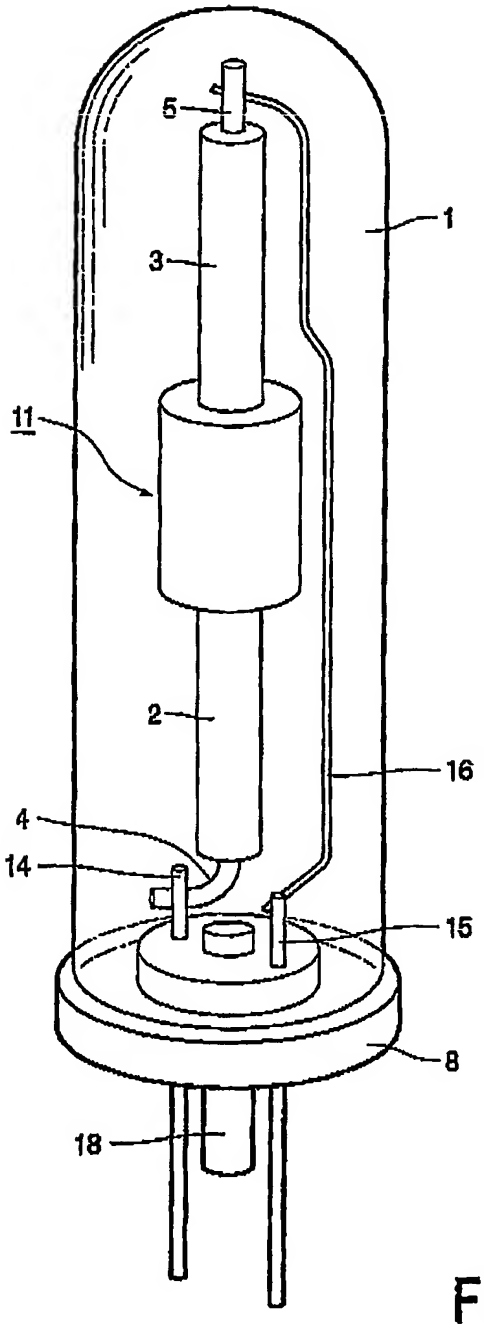

FIG. 1A

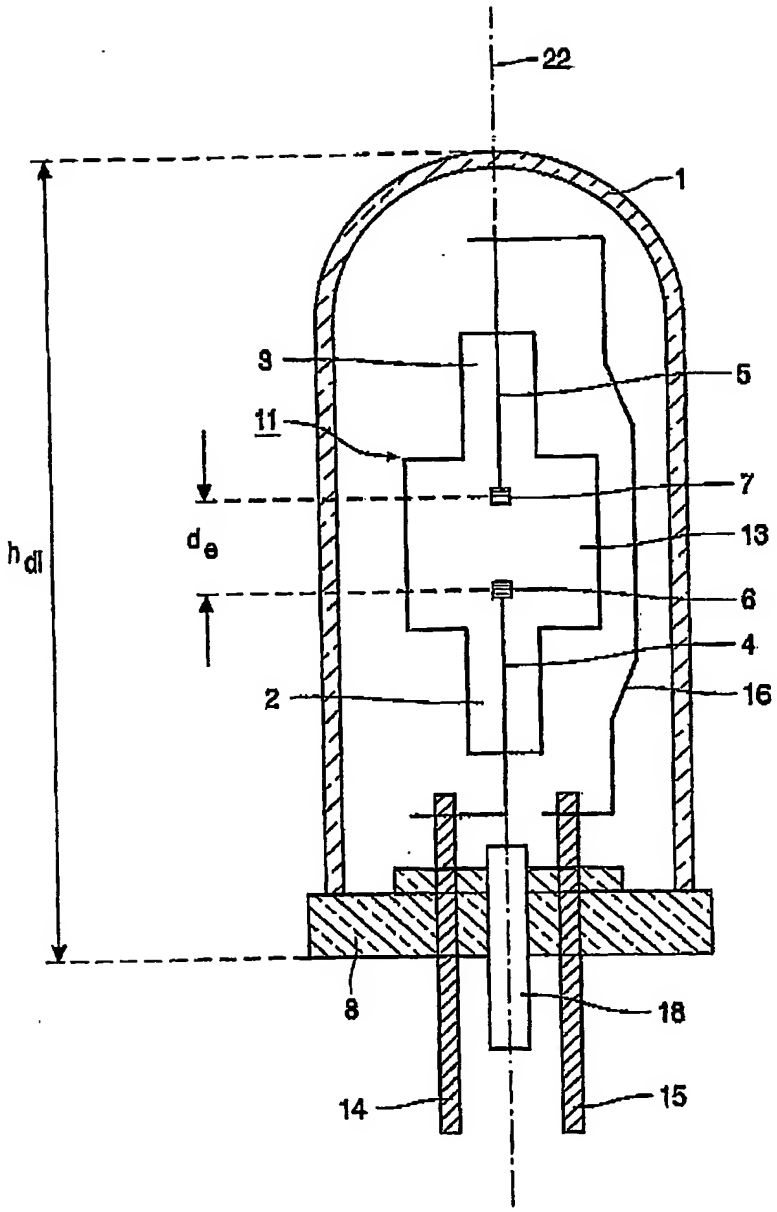

FIG. 1B

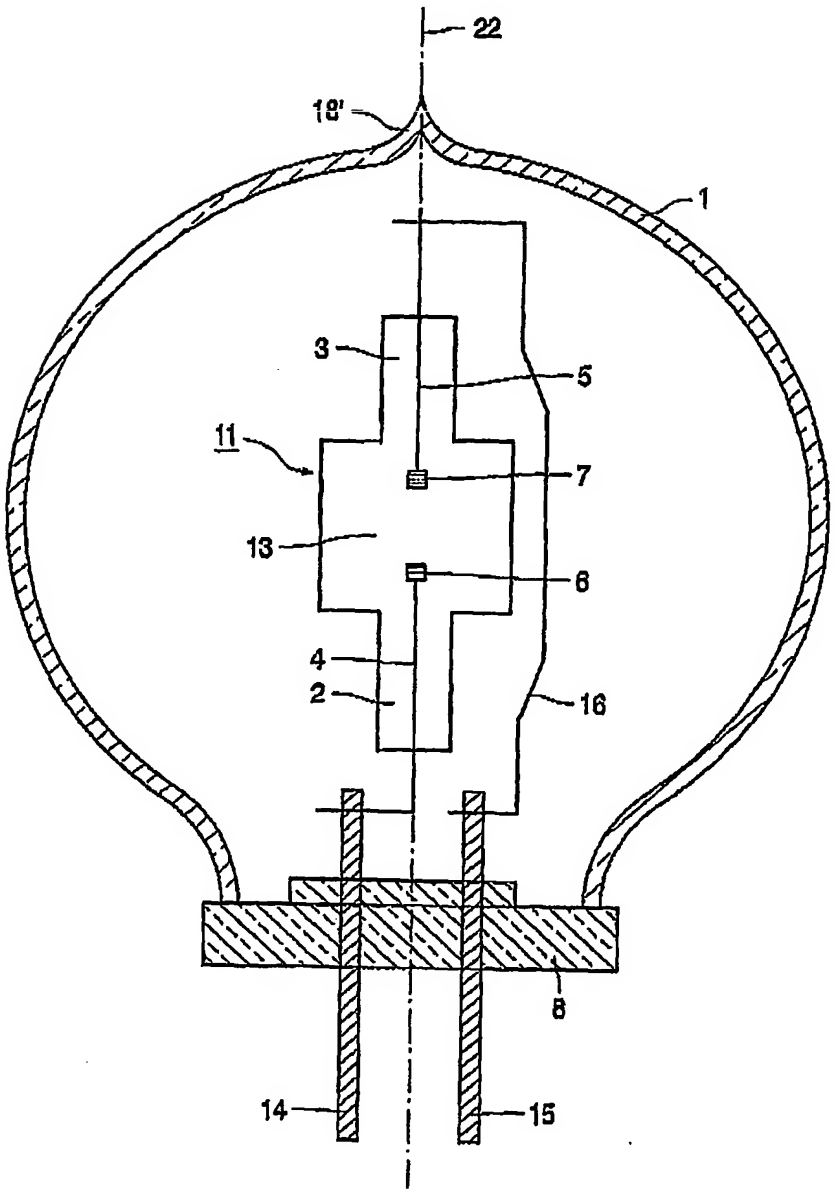

FIG. 2

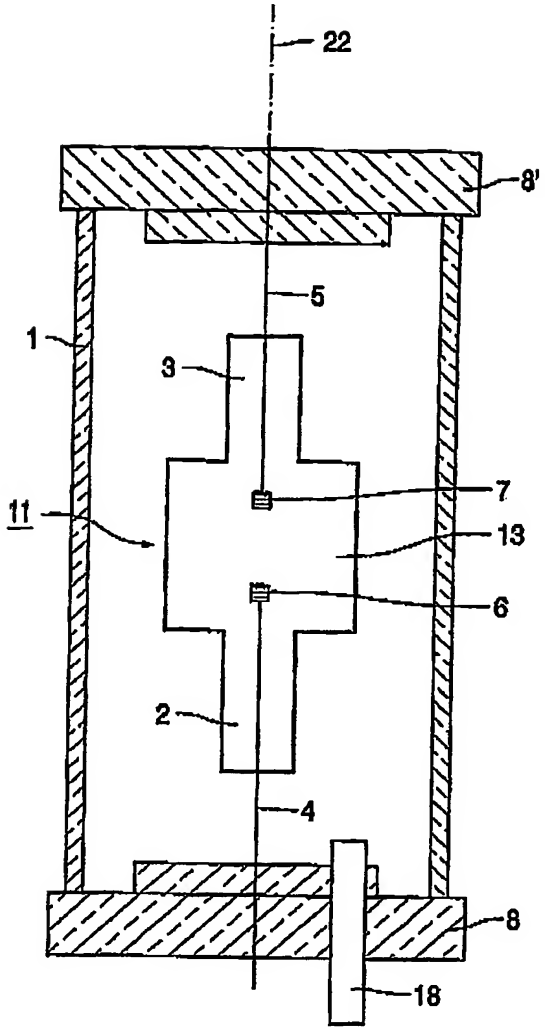

FIG. 3

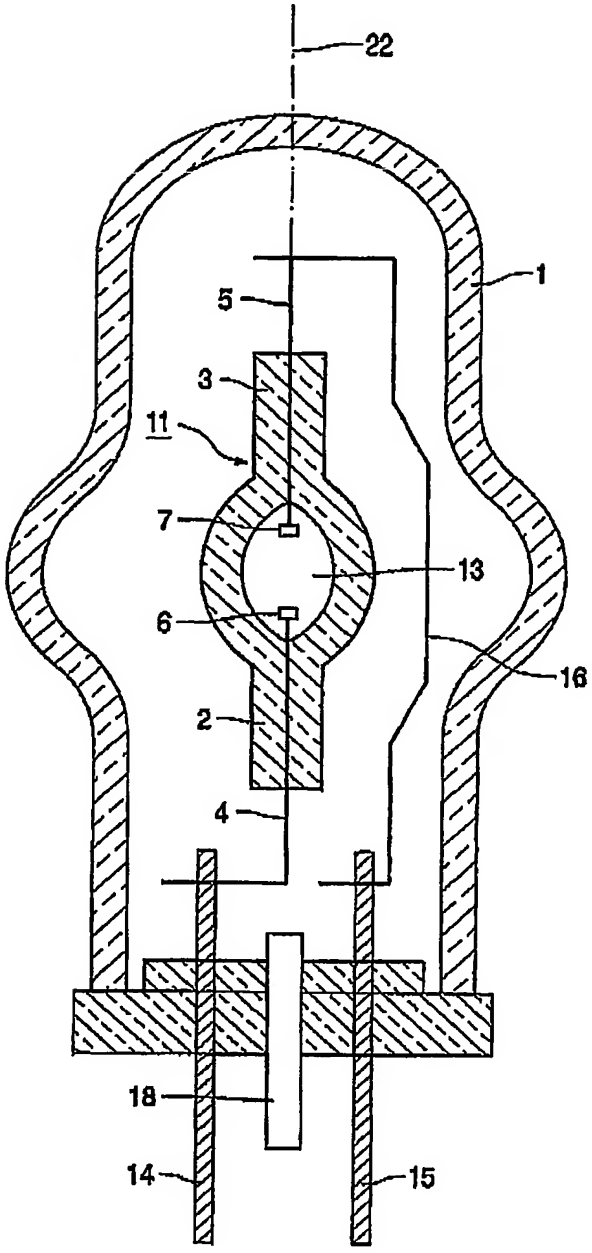

FIG. 4

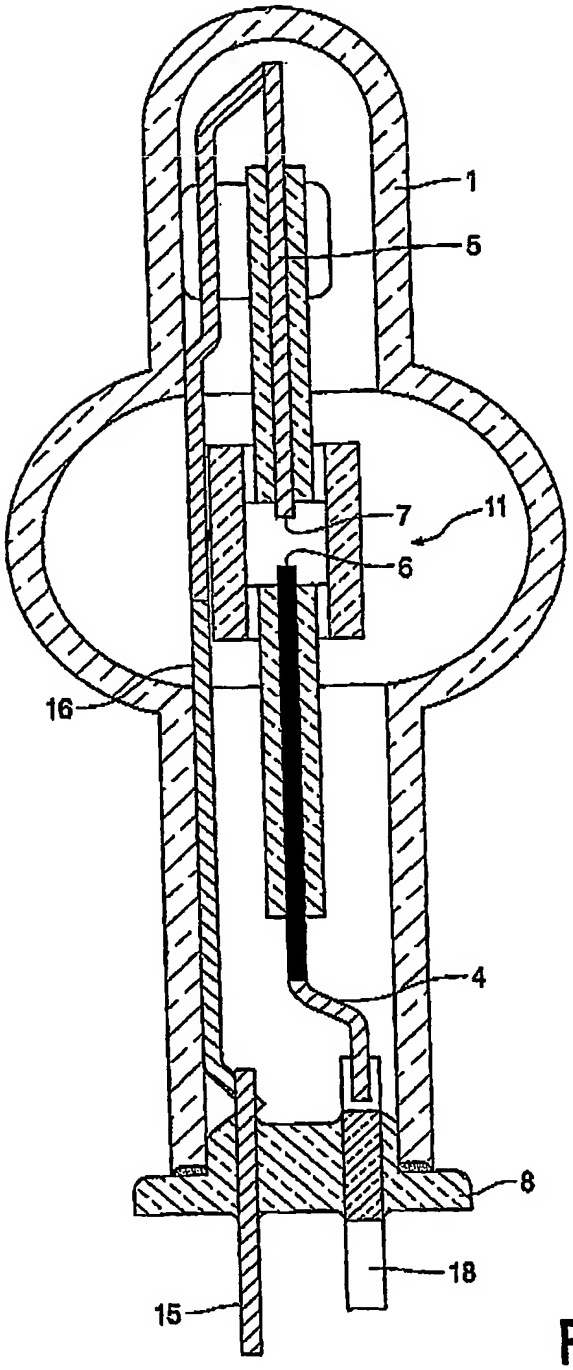

FIG. 5